

having secured to its left end (as seen in FIG. 5) a bracket 54 for supporting a rotatable shaft 56 through a shaft sealing device 58. The impeller 10 is fastened by a nut 60 to one end of the rotatable shaft 56 extending into the casing 52, and a motor, not shown, is connected to an opposite end of the rotatable shaft 56. A packing gland 62 is threadably fitted in the bracket 54 to hold the shaft sealing device 58. A cover 64 is applied to the left end (as seen in FIG. 5) of the casing 52.

The casing 52 has an inlet port 68 of an annular fluid channel 66 extending along the blade inlet surface 12a, and an outlet port 72 located tangentially to an annular fluid channel 70 located adjacent the blade outlet. According to the invention, a stationary guide vane 74 (see FIGS. 7 and 8) extending radially with respect to the axis of rotation of the rotatable shaft 56 is secured to the cover 64 and located immediately before the impeller 10. The stationary guide vane 74 is essential to the centrifugal pump according to the invention, because of the large diameter of the blade 16 at the inlet of the impeller 10, if no stationary guide vane were provided, a fluid flow formed in a cylindrical form at the inlet of the impeller would rotate in the direction of rotation of the impeller. If a rotation of such cylindrical fluid flow occurred, the performance of the pump would be reduced because it would be difficult to slice off the cylindrical fluid flow form at the inlet of the impeller.

FIG. 6 shows the result of experiments conducted on the centrifugal pump according to the invention which is provided with the impeller 10 and the stationary guide vane 74. Table 1 shows the specifications of the impeller 10 used in the experiments. In the diagram shown in FIG. 6, the abscissa represents the discharge quantity Q and the ordinate indicates the brake force power P, total head H and efficiency  $\eta$ . Calculation done on the data obtained by the experiments shows that the specific speed  $N_s$  has a value of 171. The efficiency  $\eta$  of the pump has proved to be similar to that of the centrifugal pumps now available commercially.

TABLE 1

Diameter of Impeller at the Inlet	66 m/m
Diameter of Hub at the Inlet	35 m/m
Maximum Diameter of Impeller at the Outlet	85 m/m
Number of Blade	1
Convolutions of Blade	1.5
RPM of Pump	2960 r.p.m.

The results of experiments show that the impeller according to the invention enables a centrifugal pump to achieve the performance which is beyond the power

of the design technology of pump impellers of the prior art to achieve.

The centrifugal pump according to the invention comprises a centrifugal impeller having at least one blade which, although it is substantially similar in configuration at the inlet to that of an axial impeller, is wound in a suitable number of convolutions and extends from the inlet to the outlet and is inclined forwardly toward the axis of rotation of the impeller at an increasingly greater angle in going from the inlet toward the outlet, and a stationary guide vane secured to the casing to operate in conjunction with the centrifugal impeller. The centrifugal impeller according to the invention has a high speed head which has not been realized by axial impellers of the prior art. Thus, the centrifugal pump provided with this type of centrifugal impeller used in combination with the stationary guide vane can achieve a high pumping performance.

What is claimed is:

1. In a centrifugal pump of the type comprising a casing:

an annular channel defining an inlet to said pump; a centrifugal impeller arranged for rotation in said casing, said centrifugal impeller including a hub and at least one blade wound in convolutions on a peripheral surface of the hub; and

a stationary guide vane which is secured to said casing in said annular fluid channel at the pump inlet, said vane extending parallel and radially with respect to the axis of rotation of the impeller and located immediately before the impeller,

the improvement comprising said centrifugal impeller having a fluid flow entrance surface substantially parallel to a blade inlet plane and substantially perpendicular to the axis of rotation of the impeller, said blade inlet plane being a plane formed by the blade inlet when the impeller is rotated, said blade being wound in a suitable number of convolutions extending from an inlet to an outlet of the blade on the hub and being forwardly inclined toward the axis of rotation of the impeller at an increasingly greater angle in going from the inlet toward the outlet of the blade, the angle of inclination of the blade with respect to the axis of rotation of the impeller being arbitrarily selected from the range between 0 and 90 degrees, and the convolutions of said blade define on the hub one or more fluid channels which are nearly equal in cross-sectional area.

2. A centrifugal pump as claimed in claim 1, wherein said impeller has 2 to 4 blades.

3. A centrifugal pump as claimed in claim 2, wherein said blade has a length such that it is wound in more than one-half convolutions which define a fluid channel on the hub.

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